

# **M. P. ANANTRAM**

## **RESEARCH INTERESTS**

*Primary:* Theory and simulation of transport in semiconductor and molecular nanostructures.

*Secondary:* Physical models for computing (nanoelectronic computing and quantum computing)

## **EDUCATION**

- Ph.D. - Purdue University, West Lafayette, IN - September 1995 [GPA 4.0/4.0]
- M.Sc. - University of Poona, Pune, India - May 1989 [S. S. Joshi award for academic excellence]
- B.Sc. - P.S.G. College of Technology, Coimbatore, India - May 1986

## **REFeree INFORMATION**

- NSF, NASA, International journals

## **EXPERIENCE**

### **Research Scientist, MRJ / NASA Ames Research Center [June 1997 - Present]**

- Modeling of quantum semiconductor structures and devices (current emphasis: 2D quantum simulator project)
- Modeling of molecular structures and devices (current emphasis: Carbon Nanotubes)
- Physical models of computing

### **Postdoctoral Fellow, University of California, Los Angeles [September 1995 - May 1996]**

- Analyzed metastability in arrays of importance to nanoelectronic computation, as a function of array size, temperature and device parameters. Modeled dynamics of quantum dot arrays using the Monte Carlo technique.
- Worked on specific models of decoherence in quantum computation and developed special case error correcting codes in collaboration with applied mathematicians.
- Solid state based model of quantum computation.
- Studied computational models: nanoelectronics, problem of interconnects.

### **Research Assistant, Purdue University, West Lafayette, IN [June 1991 - September 1995]**

- Developed a formulation to describe ac transport in ultra small devices.
- Modeled the ac response of Quantum Dots and Resonant Tunneling Diodes by including phonon scattering and the effect of electron charging.
- Modeled current and current fluctuations in ultra small devices with superconducting boundaries.

### **Teaching Assistant, Purdue University, West Lafayette, IN [August 1989 - May 1991]**

- Worked with students in off-site industries.
- Conducted recitation and laboratory classes in undergraduate physics.

### **Summer Intern, Tata Institute of Fundamental Research, India [May - June 1988]**

- Studied and wrote a report on dissipation in quantum systems.

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## PUBLICATIONS

### Book Chapters

### Review Articles

- *Scattering Theory of Mesoscopic Superconductivity*, S. Datta, P. F. Bagwell and M. P. Anantram, Physics of Low Dimensional Structures Vol. 3, p. 1 (1996).

### Regular Articles (refereed)

### Device Modeling (Semiconductor and Superconductor; Theory and Modeling)

- *Steady-State Transport in Mesoscopic Systems Illuminated by Alternating Fields*, S. Datta and M. P. Anantram, Phys. Rev. B, vol. 45, p. 13762 (1992).
- *Rate Equations for the Phonon Peak in Resonant Tunneling Diodes*, R. K. Lake, G. Klimeck, M. P. Anantram and S. Datta, Phys. Rev. B, vol. 48, p. 15132 (1993).
- *Resonant Tunneling Devices: Effect of Scattering (invited)*, S. Datta, G. Klimeck, R. K. Lake and M. P. Anantram, 21st International Symposium on Compound Semiconductors, San Diego, September 18-22 (1994), Inst. Phys. Conf. Ser. No. 141, Chapter 7, pages 775-780.
- *Effect of Phase-Breaking on the ac Response of Mesoscopic Systems*, M. P. Anantram and S. Datta, Phys. Rev. B, vol. 51, p. 7632 (1995).
- *Current Fluctuations in Mesoscopic Systems with Superconducting Regions*, M. P. Anantram and S. Datta, Phys. Rev. B, Phys. Rev B, vol. 53, p. 16390 (1996).
- *Charging effects in the ac conductance of a double barrier resonant tunneling structure*, M. P. Anantram, Journal of Physics: Condensed Matter, vol. 10, p.9015 (1998)

### Nanotechnology / Molecular Electronics

- *Transport in Carbon Nanotubes with Defects*, M. P. Anantram, J. Han and T. R. Govindan, Ann. of the New York Acad. of Sc. vol. 852, p. 169 (1998)
- *Observation and Modeling of Single Wall Carbon Nanotube Bend Junctions*, Jie Han, M. P. Anantram, R. Jaffe and H. Dai, Phys. Rev. B, vol. 57, p. 14983 (1998)
- *Conductance in carbon nanotubes with defects: A numerical study*, M. P. Anantram and T. R. Govindan, Phys. Rev. B, vol. 58, p.4882 (1998)
- *Bandgap change of carbon nanotubes : Effect of small uniaxial and torsional strain*, Liu Yang, M. P. Anantram, Jie Han and J. P. Lu, Phys. Rev. B, vol. 60, p. 13874 (1999)
- *Transport through nanotubes with polyhedral caps*, M. P. Anantram and T. R. Govindan, Phys. Rev. B, vol. 61, p. 5020 (2000)
- *Coupling of carbon nanotubes to metallic contacts*, M. P. Anantram, S. Datta and Y. Xue, Phys. Rev. B, vol. 61, p. 14219 (2000)
- *Single Particle Transport through Carbon Nanotube Wires: Effect of Defects and Polyhedral Cap*, M. P. Anantram and T. R. Govindan, "Science and Application of Nanotubes", D. Tomanek and R. J. Enbody (eds.), Kluwer Academic / Plenum Publishers (1999)
- *Current-carrying capacity of nanotubes*, M. P. Anantram, Phys. Rev. B, vol. 62, p. 4837 (2000)

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- Which nanowire couples better to a metal contact: Armchair or Zigzag nanotube?, M. P. Anantram, Appl. Phys. Lett., To appear in April 02, 2001 issue

## Physical Models of Computing

- *Can metastable states affect ground state computing*, M. P. Anantram and V. P. Roychowdhury, Proceedings of the Fourth Workshop on Physics and Computation, Boston University, PhysComp 96, Editors T. Toffoli, M. Biafore and J. Leao, pages 17-21
- *Fundamental issues in atomic/nanoelectronic computation*, M. P. Anantram and V. P. Roychowdhury, Book Chapter in "Communication, Computing, Control and Signal Processing", A. Paulraj, V. P. Roychowdhury and C. Shaper (eds.), Kluwer Academic Press, Boston (1997), p. 219
- *Spatially correlated qubit errors and burst-correcting quantum codes*, F. Vatan, V. P. Roychowdhury, M. P. Anantram, Accepted for publication in IEEE Transactions on Information Theory, vol. 45, p. 1703 (1999).
- *Metastable states and information propagation in a one-dimensional array of locally coupled bistable-cells*, M. P. Anantram and V. P. Roychowdhury, Journal of Applied Physics, vol.85, p.1622 (1999).
- *Quantum computation by optically coupled steady atom or quantum dots inside a QED cavity*, P. Pradhan, M. P. Anantram and K. L. Wang, Preprint (2000).

## CONFERENCE PRESENTATIONS

### Device Modeling (Semiconductor and Superconductor; Theory and Modeling)

- *Role of Excursion Principle in a Scattering Approach to Inelastic Transport*, M. P. Anantram and S. Datta, March Meeting of the American Physical Society, 1993
- *Linear Response ac Conductance with Phase-Breaking Scattering*, M. P. Anantram and S. Datta, March Meeting of the American Physical Society, 1994
- *Resonant Tunneling Devices: Effect of Scattering*, S. Datta, G. Klimeck, R. K. Lake and M. P. Anantram, 21st International Symposium on Compound Semiconductors, San Diego, September 18-22 (1994) (invited)
- *Current and Noise in Mesoscopic Structures with Andreev Scattering*, M. P. Anantram and S. Datta, March Meeting of the American Physical Society, March 20-24, 1995
- *Current Fluctuations in Mesoscopic Structures with Superconducting Boundaries*, M. P. Anantram and S. Datta, The Eight International Conference on Superlattices, Microstructures and Microdevices (ICSMM-8), August 20-25, 1995, Cincinnati
- *2D quantum simulation of MOSFET using the non equilibrium Green's function method*, Alexei Svizhenko, M. P. Anantram and T. R. Govindan, 7th International Workshop on Computational Electronics, Glasgow, Scotland, May 22-25, 2000
- *2D quantum simulations using the Green's function method: Really necessary?*, Alexei Svizhenko, M. P. Anantram, T. R. Govindan and Bryan Biegel, 'Challenges in Advanced Electronic Device Simulation ---A Workshop and Forum for Discussion---', September 5, 2000, Seattle, Washington (invited)
- *2D Quantum Mechanical Study of Nanoscale MOSFETs*, A. Svizhenko, M.P. Anantram, and T.R. Govindan, B.Biegel, 2nd Workshop on Computational Material and Electronics, Tempe, AZ, Nov. 9-10, 2000 (invited)

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- *2D Quantum Transport Modeling in Nanoscale MOSFETs*, A. Svizhenko, M. P. Anantram, T. R. Govindan, B. Biegel, Bulletin of the American Physical Society, Vol. 46, March 2001 Meeting Program, Seattle, WA, March 11-16, 2000

## Molecular Electronics

- *Transport in carbon nanotubes with defects*, M. P. Anantram, Jie Han and T. R. Govindan, International conference on molecular electronics: Science and Technology, 14-18, December 1997, Humacao, PR 00791, U. S. A.
- *Electronic Properties of Carbon Nanotubes and Junctions*, M. P. Anantram, Jie Han, Liu Yang, T. R. Govindan and R. Jaffe, The International Conference on Integrated Nano / Microtechnology for Space Applications, Houston, Texas, November 1-6, 1998.
- *Electro-mechanical properties of carbon nanotubes: Effect of small tensile and torsional strains*, M. P. Anantram, Liu Yang, Jie Han and J. P. Lu, American Physical Society Meeting, Atlanta, Georgia, March 20-26, 1999.
- *Bonding Geometries and Bandgaps of Carbon Nanotubes Under Uniaxial and Torsional Strains*, Liu Yang, Jie Han, M.P. Anantram, J.P. Lu, R. Jaffe, American Physical Society Meeting, Atlanta, Georgia, March 20-26, 1999
- *Conductance of Carbon Nanotubes*, S. Datta, Y. Xue and M. P. Anantram, American Physical Society Meeting, Atlanta, Georgia, March 20-26, 1999.
- *Coupling of nanotube to metals contacts*, M. P. Anantram, S. Datta, Liu Yang, Jie Han and T. R. Govindan, 1999 Joint International meeting of the Electrochemical Society, Honolulu Hawii, October 17-22, 1999
- *Mechanical and Electronic Properties of Carbon Nanotubes Under Bending*, L. Yang, M.P. Anantram, J. Han and R.L. Jaffe, AVS 46th International Symposium, Seattle, WA, October 25-29, 1999.
- *Nanotubes in Nanoelectronics: Transport studies*, M. P. Anantram, L. Yang, J. Han, and M. Meyyappan, Nanospace 2000, Houston, TX, January 2000.
- *Theory and Simulation of Electronic Structure of Deformed Carbon Nanotubes*, Liu Yang, Jie Han, M. P. Anantram, Richard Jaffe, Jianping Lu, American Physical Society Meeting, Minneapolis, Minnesota, March 20-24, 2000
- *Transport through carbon nanotube wires*, M. P. Anantram, 7th International Workshop on Computational Electronics, Glasgow, Scotland, May 22-25, 2000
- *Transport through non crossing sub-bands of a carbon nanotube*, M. P. Anantram, American Physical Society Meeting, Minneapolis, Minnesota, March 20-24, 2000
- *Transport through carbon nanotube wires*, M. P. Anantram, 7th International Workshop on Computational Electronics, Glasgow, Scotland, May 22-25, 2000.
- *Modeling of electron flow in carbon nanotubes*, 42nd Electronic Materials Conference, June 21-23 2000, Denver, Colorado (invited)
- Carbon nanotube transport: An intrinsic back scattering mechanism & coupling to metals, M.P. Anantram, 2nd Workshop on Computational Material and Electronics, Tempe, AZ, Nov. 9-10, 2000 (invited)
- *Coupling of armchair and zigzag tubes to a free electron metal*, M.P. Anantram, Bulletin of the American Physical Society, Vol. 46, March 2001 Meeting Program, Seattle, WA, March 11-16, 2000

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## Physical Models of Computing

- *Effect of Dynamics and Imaging on Ground State Computing*, M. P. Anantram and V. P. Roychowdhury, Single Electron Nanoelectronics, 190th Electrochemical Society Meeting, October 6-11, 1996, San Antonio, Texas.
- *Can metastable states affect ground state computing*, M. P. Anantram and V. P. Roychowdhury, Proceedings of the Fourth Workshop on Physics and Computation, Boston University, November 22-24, 1996, Boston, USA. PhysComp 96, Editors T. Toffoli, M. Biafore and J. Leao, pages 17-21 (publication number 9).
- *On computing with locally-interconnected architectures in atomic/nanoelectronic systems*, V. P. Roychowdhury, M. P. Anantram, IEEE International Conference on Applications-Specific Systems, Architectures and Processors, Zurich, Switzerland, 14-16 July 1997.
- *Quantum computation using optically coupled quantum dot arrays*, M. P. Anantram, Prabhakar Pradhan, K. L. Wang, V. P. Roychowdhury, 1st NASA International Conference on Quantum Computing & Quantum Communications (NASA QCQC'98), Palm Springs, CA, February 17 - 20, 1998
- *Quantum computation by optically coupled steady atoms/quantum-dots inside a quantum cavity*, P. Pradhan, T. Mor, V. P. Roychowdhury, K. L. Wang and M. P. Anantram, American Physical Society Meeting, Atlanta, Georgia, March 20-26, 1999

## ADDRESS

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